SOLID-STATE AMPLIFIER MAY COMPETE WITH MICROWAVE VACUUM TUBES

Can You Imagine . . .

. . . a solid-state alternative to vacuum tubes for generating and amplifying radio frequency and microwave power.

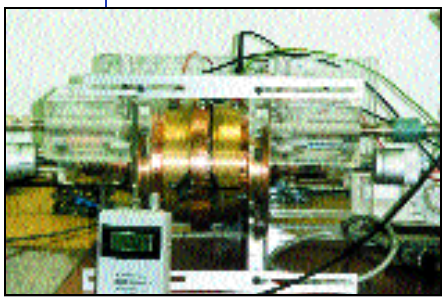
Solid-state devices, such as transistors and integrated circuits, have replaced most vacuum tubes. However, microwave vacuum tubes are an important exception and are still used in such diverse applications as radar, space communications, and television broadcasting equipment. Because solid-state devices cannot handle high-power loads at microwave radio frequencies, microwave vacuum tubes remain the chosen technology to amplify high power.

Aria Microwave Systems, Inc. (AMS; Englewood, NJ), developed a new active radio frequency (RF) cavity concept and prototype that can replace vacuum tubes with solid-state technology. This concept integrates low-power solid-state transmitters into the walls of a resonant cavity, forming a single, high-power structure called the active RF cavity amplifier (ARFCA). With this design, the amplifier handles high-power loads at radio and microwave frequencies with efficiencies approaching those of intrinsic solid-state devices.

With this unique capability, the ARFCA provides an alternative to vacuum tubes for generating and amplifying RF and microwave power. With voltage requirements 1,000 times less than conventional vacuum electron tubes and a cheaper power supply, the amplifier will use smaller, less expensive power conditioning equipment. This rugged and repairable device requires no vacuum, magnets, or complex electrodes, and it can be easily fabricated.

ARIA MICROWAVE IS NOW BUILDING PROTOTYPES FOR EXISTING AND EMERGING COMMERCIAL APPLICATIONS.

Under BMDO SBIR funding, AMS has proved the concept with a device that combines the output of six RF transistors at 1.8 gigahertz. The company is currently building two more prototypes for existing and emerging commercial applications. One will use 60 transistors to achieve an output of 1.8 kilowatts (kW) of ultrahigh frequency (UHF) power at 915 megahertz (mHz). This technology could eventually be used in commercial transmitters such as television, radar, satellite, and cellular communications, all of which are currently dominated by vacuum tubes.



■ Pictured above is Aria Microwave's active radio frequency cavity prototype. It requires no vacuum, magnets, or complex electrodes, and can be easily fabricated.

The second prototype, designed to serve the industrial heating market, contains 20 transistors to produce 1 kW of UHF power at 915 mHz. This ARFCA could replace magnetrons, which produce heat via microwaves for pharmaceutical and petroleum processing. Its reduced power consumption, longer lifetime, and gradual failure rate would make the amplifier cost-competitive with magnetrons. Furthermore, the amplifier would be safer than its high-voltage competitor; for example, magnetrons usually fail catastrophically, which could spark an explosion in chemical plants. The ARFCA's gradual failure mechanism would protect such volatile environments.

ABOUT THE TECHNOLOGY

The ARFCA combines the output from many low-power, solid-state devices into a single high-power device or structure. In the ARFCA, the cavity simultaneously acts as the power combiner, matching transformer, and heat sink. A waveguide or coaxial cable guides the RF and microwave power out of the ARFCA. Dr. Bernard Cheo, inventor of the ARFCA, states that only the number of transistors that can physically fit around the cavity limits the maximum output power. The first prototype produced a combining efficiency exceeding 90 percent.